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ETIOLOGICAL AGENTS OF FUNGAL INFECTIONS IN REPTILES

INTRODUCTION

Mycoses are infections produced by fungi in humans and animals. Dermatomycoses are the most frequently reported manifestation of fungal diseases in reptiles.

OBJECTIVE

Revision of the most important etiological agents of fungal infections in reptiles, of the diagnostics procedures that are used to identify it and the possible treatments.

Figure 1. Green iguana showing ulcerative dermatitis in the leg.

Figure 2. Coastal bearded dragon showing extensive ulceration of the skin.

Chrysosporium anamorph of *Nannizziopsis vriesii* (CANV) has been considered the most significant pathogenic fungus in dermatomycoses.

Year	Specie in which is isolated	Isolated specie	Who isolates	Country
	Lizards			
1997	*Chamaeleo parsonii*	CANV	Paré et al.	Canada
1997	*Chamaeleo lateralis*	CANV	Paré et al.	Canada
1997	*Chamaeleo jacksonii*	CANV	Paré et al.	Canada
1997	*Furcifer pardalis*	CANV	Paré et al.	Canada
2003	*Phelsuma* sp.	CANV	Paré et al.	USA
2006	*Ameiva chaitzarni*	CANV	Martell et al.	Germany
2006	*Chamaeleo calyptratus*	CANV	Paré et al.	USA
2007	*Pogona vitticeps*	CANV	Bowman et al.	USA
2008, 2010	*Iguana iguana*	*Chrysosporium* sp. (*Chrysosporium guarroi*)	Abarca et al.	Spain
2009, 2013	*Pogona vitticeps*	*Chrysosporium* sp. (*Chrysosporium draconii*)	Abarca et al.	Spain
2010	*Cordylus giganteus*	CANV	Hellebuyck et al.	Belgium
2011	*Pogona barbata*	CANV	Johnson et al.	Australia
2011	*Anolis sagrei*	CANV	Burcham et al.	USA
2013	*Eublepharis macularius*	CANV	Toplon et al.	USA
	Snakes			
1999	*Boiga irregularis*	CANV	Nichols et al.	USA
1999	*Thamnophis* sp.	*Chrysosporium queenslandicum* i *Geotrichum candidum*	Vissiennon et al.	Germany
2003	*Phyton regius*	CANV	Paré et al.	USA
2003	*Lampropeltis triangulum*	CANV	Paré et al.	USA
2003	*Pantherophis guttatus*	CANV	Paré et al.	USA
2005	*Erpeton tentaculum*	CANV	Bertelsen et al.	Southeast Asia
2008	*Eunectes murinus murinus*	CANV	Sigler et al.	USA
2009	*Elaphe obsoleta obsoleta*	*Chrysosporium ophiodiicola*	Rajeev et al.	USA
2010	*Boa constrictor constrictor*	CANV	Eatwell	Scotland
2010	*Hoplocephalus bungaroides*	CANV	McLelland et al.	Australia
2011	*Sistrurus catenatus catenatus*	*Chrysosporium* sp.	Allender et al.	USA
	Crocodiles			
2002	*Crocodylus porosus*	CANV	Thomas et al.	Australia

Table 1. Reptile species infected by CANV or by Chrysosporium species related to it.

This concept has changed over the years

Species	Source
Nannizziopsis (Currah, 1985)	
Nannizziopsis vriesii (Currah, 1985)	Lizard (*Ameiva* sp.)
Nannizziopsis guarroi (Cabañes et al., 2013)	Iguana (*Iguana iguana*), bearded dragon (*Pogona vitticeps*), lizard (*Agama agama*), snake
Nannizziopsis draconii (Cabañes et al., 2013)	Bearded dragon (*Pogona vitticeps*)
Nannizziopsis chlamydospora (Stchigel et al., 2013)	Bearded dragon (*Pogona vitticeps*)
Nannizziopsis pluriseptata (Stchigel et al., 2013)	Lizard (*Eumeces inexpectatus*)
Nannizziopsis arthrosporioides (Stchigel et al., 2013)	Water dragon (*Physignathus* sp.)
Nannizziopsis dermatitidis (Sigler et al., 2013)	Chameleon, gecko
Nannizziopsis crocodili (Sigler et al., 2013)	Crocodile (*Crocodylus porosus*)
Nannizziopsis barbata (Sigler et al., 2013)	Bearded dragon (*Pogona barbata*)
Nannizziopsis hominis (Sigler et al., 2013)	Human
Nannizziopsis infrequens (Sigler et al., 2013)	Human
Nannizziopsis obscura (Sigler et al., 2013)	Human
Paranannizziopsis (Sigler et al., 2013)	
Paranannizziopsis australasiensis (Sigler et al., 2013)	Turtle (*S. punctatus punctatus*), bearded dragon (*Pogona barbata*), water snake (*Acrochordus* sp.)
Paranannizziopsis californiensis (Sigler et al., 2013	Snake (*Erpeton tentaculum*)
Paranannizziopsis crustacea (Sigler et al., 2013	Snake (*Erpeton tentaculum*)
Paranannizziopsis longispora (Sigler et al., 2013	Snake (*Erpeton tentaculum*)
Ophidiomyces (Sigler et al., 2013)	
Ophidiomyces ophiodiicola (Sigler et al., 2013)	Snakes

Table 2. Result of recent taxonomic revisions adapted by (Sigler et al., 2013) and (Stchigel et al., 2013).

DIAGNOSIS

For the definitive diagnosis of mycoses the culture and the histopathology are required.

Figure 3. Colonial morphology in Sabouraud dextrose agar.

Temperature: 25-35ºC
Duration: 24-48h (yeasts) to 5-7d (mycelial fungus)

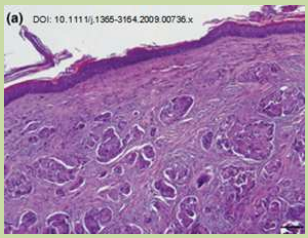

Figure 4. Haematoxylin and eosin stain showing multiple coalescing granulomas in the dermis.

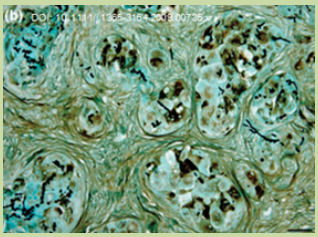

Figure 5. Grocott's methenamine silver (GMS) stain showing fragments of hyphae.

CONCLUSIONS

- 17 species in 3 genus.
- The genus *Ophidiomyces* only affects snakes. But the genus *Nannizziopsis* and *Paranannizziopsis* affects different species of reptiles.
- *N. hominis*, *N. infrequens* and *N. obscura* only affects humans. These species don't affect reptiles. No direct transmission of reptiles to humans, but prevention is important.
-Although important discoveries have been made research in this field should continue.

TREATMENT

Effective antifungal for a minimum of 2 to 4 weeks + supportive care measures such as fluid therapy and nutritional support if required.

Drug	Reptile species	Dosage	Result	Species of fungus	Reference
Oral ketoconazol + 2% chlorhexidine solution + topical terbinafine	*Iguana iguana*	Ketoconazol (20mg/kg/24h)	Effective	*Chrysosporium* sp. (*Chrysosporium guarroi*)	Abarca et al., 2008
Oral ketoconazol + 2% chlorhexidine solution + topical terbinafine	*Pogona vitticeps*	Ketoconazol (20mg/kg/24h)	Effective	*Chrysosporium* sp. (*Chrysosporium draconii*)	Abarca et al., 2009
Itraconazol	*Chamaeleo parsonii*	10mg/kg/24h	Effective	CANV	Paré et al., 1997
Itraconazol	*Pogona vitticeps*	10mg/kg/24h	Poor	CANV	Bowman et al., 2007
Itraconazol	*Pogona vitticeps*	5mg/kg/48h	Positive	CANV	Bowman et al., 2007
Itraconazol	*Boa constrictor*	5mg/kg/24h	Non-effective	CANV	Eatwell, 2010
Itraconazol	*Pogona barbata*	5mg/kg/24h	Non-effective	CANV	Johnson et al., 2011
Itraconazol	*Pogona barbata*	10mg/kg/24h	Non-effective	CANV	Johnson et al., 2011
Voriconazol	*Cordylus giganteus*	10mg/kg/24h	Effective	CANV	Hellebuyck et al., 2010
Voriconazol	*Pogona vitticeps*	10mg/kg/24h	Safe and effective	CANV	Van Waeyenberghe et al., 2010
Skin lesions debridement + iodine + formalin	*Crocodylus porosus*	---------	Effective	CANV	Thomas et al., 2002

Table 3. Antifungals used in reptiles infected by CANV or by Chrysosporium species related to it.

Systemic drugs combined with topical drugs are the best choice to treat the dermatomycoses.